

PATENT CLAIMS

1. Substrate for packaging of or for attachment to products which are sensitive to aging and temperature, having a time-temperature integrator arranged in the region of the substrate, characterised in that the time-temperature integrator contains a matrix and at least one reversible indicator embedded therein, which has photochromic properties on the basis of transfer reactions.
2. Substrate according to claim 1, characterised in that the substrate is a packaging material.
3. Substrate according to claim 1 or 2, characterised in that the transfer reactions are based on the transfer of charged or uncharged hydrogen atoms or hydrogen isotopes.
4. Substrate according to one of the preceding claims, characterised in that the reversible indicator has a skeletal structure according to the general formula I:

(Formula page 2 of claims)

wherein $A_1 - A_5$ = carbon atom and/or a heteroatom, such as for example N, S, O

$R_1 - R_4$ = hydrogen atom and/or an isotope thereof, and/or Cl, F, Br or a substituent, such as for example alkyl groups, in particular methyl groups or aryl groups, in particular phenyl groups.

R_5 = H, D or T or a substituent, such as for example Cl, F, Br or an alkyl group, in particular methyl group or an aryl group, in particular phenyl or pyridine, and

R_6 = H, D, T

$B_1 - B_7$ = carbon atom and/or a heteroatom, such as for example N, S, O.

$R_1 - R_{10}$ = hydrogen atom and/or an isotope thereof, and/or one or more Cl, F, Br, amino groups or nitro groups or one or more substituents, such as for example alkyl groups, in particular methyl or aryl groups, in particular phenyl, and

R_{11} = nitro group or a cyano group or a carboxylic acid group or a variant, such as for example an ester, amide, ketone or aldehyde group.

5. Substrate according to one of the preceding claims, characterised in that the reversible indicator has a skeletal structure according to the general formula II:

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(Formula page 3 of claims)

- wherein $A_1 - A_{12}$ = carbon atom and/or a heteroatom, (such as for example N, S, O.)
- $R_1 - R_7$ = hydrogen atom and/or an isotope thereof, and/ or Cl, F, B or other substituents, (such as for example alkyl groups, in particular methyl or aryl groups, in particular phenyl.)
- R_8 = H, D, T or a substituent, (such as for example Cl, F, Br or an alkyl group, in particular methyl or an aryl group, in particular phenyl or pyridine.)
- R_9 = H, D, T
- $B_1 - B_7$ = carbon atom and/or heteroatom (such as for example N, S, O.)

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$R_{10} - R_{13}$ = hydrogen atom and/or an isotope thereof, and/or one or more Cl, F, Br, amino groups or nitro groups, or one or more substituents, (such as alkyl groups, (in particular methyl or aryl groups, in particular phenyl.)

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 R_{14} = nitro group or a cyano group or a carboxylic acid group or a variant, (such as for example an ester, amide, ketone or aldehyde group.)

- Sub 267*
 6. Substrate according to one of claims 4 or 5, characterised in that in the general formula I and II, $R_4 = NO_2$ and 2 - 4 NO_2 groups are present.
- Sub 287*
 7. Substrate according to claim 1 or 2, characterised in that the transfer reactions are based on large, charged or uncharged groups.
- Sub 287*
 8. Substrate according to claim 1 or 2, characterised in that the transfer reactions are based on a charged or uncharged halogen atom.
- Sub 287*
 9. Substrate according to one of the preceding claims, characterised in that the reversible indicator has more than one characteristic time domain.
- Sub 287*
 10. Substrate according to one of the preceding claims, characterised in that at least two reversible indicators having different characteristic time domains are embedded in the matrix.
- Sub 287*
 11. Substrate according to one of the preceding claims, characterised in that the reversible indicator has photo-induced colouration.
- Sub 287*
 12. Substrate according to one of the preceding claims, characterised in that at least one irreversible indicator having photochromic properties is arranged in the region of the reversible indicator.

13. Substrate according to one of the preceding claims, characterised in that the time-temperature integrator has a filter which is impermeable to light, which effects photo-induced colouration of the reversible indicator.
14. Substrate according to claim 13, characterised in that the filter is impermeable in the wavelength range of a wavelength preferably below 430 nm.
15. Substrate according to one of the preceding claims, characterised in that the substrate includes a reference scale arranged in the region of the time-temperature integrator.
16. Substrate according to one of the preceding claims, characterised in that the matrix is a polymer film.
17. Substrate according to one of the preceding claims, characterised in that the substrate is a polymer film.
18. Substrate according to one of the preceding claims, characterised in that a substrate region forms the matrix for the reversible indicator.
19. Process for determination of quality of products which are sensitive to aging and temperature and are provided with a substrate according to one of claims 1 to 18, containing the steps:
 - a) photo-induced colouration of the reversible indicator; and
 - b) determination of the degree of time-related or temperature-related discolouration and the quality of the product taking into account the degree of discolouration.

Sub 3197 20. Process according to claim 19, characterised in that the determination of the quality of the product is effected by evaluating the degree of discolouration with the aid of the reference scale.

Sub 3207 21. Process according to claim 19 or 20, characterised in that the irreversible indicator is applied after optically induced colouration of the reversible indicator.

Sub 3217 22. Process according to one of claims 19 to 21, characterised in that the filter is applied after optically induced colouration.

Sub 3227 23. Process according to one of claims 19 to 22, characterised in that the optically induced colouration of the reversible indicator is effected by UV or near UV light.

Sub 3237 24. Process according to one of claims 19 to 23, characterised in that the optical activation of the time-temperature integrator is effected by irradiation of the side of the time-temperature integrator opposite the filter.

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